Crude Injustice: A Multiscalar Spatial Configuration of Oil Trains and Environmental Justice

Thesis Presented in Partial Fulfillment of the Requirements for the Honors Degree of Bachelor of Science in the School of Environment and Natural Resources

By: Maria Fredericks
The Ohio State University
Spring 2019

Thesis Advisor:
Jeffrey B. Jacquet

Thesis Committee from The Ohio State University:
Drs. Jeffrey B. Jacquet, Cathy Rakowski, and Stacey Fineran
School of Environment and Natural Resources, The Ohio State University

Acknowledgements

I am greatly indebted to the love, support, and encouragement of many throughout my thesis process. First and foremost, I want to thank my research advisor, Dr. Jeffrey Jacquet in the School of Environment and Natural Resources for all his support in the thinking, data collection, writing, and defending of this thesis. I approached him absolutely fearful and unsure of undergraduate research, and with his unquestioning reassurance, I have reached new academic heights I never before knew existed. Without his words, countless recommendations, and continued support throughout the writing of this thesis, I would not be where I am today.

To my faculty advisor, Dr. Cathy Rakowski, for empowering me to consider research, to take my abilities internationally, and for seeing my potential and lifting me up in SENR.

To Dr. Pintor for spending so much time with me in the halls of Kottman and after class graciously showering me with words of encouragement. Seeing such an incredible woman accomplish so much in her field showed me in an embodied way that research *is* possible.

To all the graduate students who have pushed me to see my future with clearer resolutions: Anne Junod, Josh Fergen, Clair Bullock.

To the incredible intellectual labor of my professors and mentors everywhere who have not only helped to shape my thinking around environmental justice and geography, but have inspired me to explore new academic depths and challenge my vision of the world: Dr. Tommy Davis, Dr. Mat Coleman, Dr. Joel Wainwright, Daniel Bryan, and Chelsea Viteri.

To my family in New York and Quito: sin ustedes no hubiera podido lograr tantos éxitos como he logrado. Todo lo que hago es por sus sacrificios y por los sacrificios de nuestros antepasados. Siempre sere agradecida por lo que han hecho por mi.

To my network of support in Columbus, New York, and Quito. My long-time friends, my Renew community, Student Farm crew, LASER, MSP and SPPO, and Pachaysana and USFQ familia. Finally, to my mama, for everything that she is and does. This thesis and diploma are for her.

Abstract

The increase of Bakken oil extraction and production in the United States in the last decade has sparked the expansion of crude-by-rail (CBR) transport. The accelerating need for CBR transport has not come without consequence, however, leaving derailments, oil spills, fires and explosions in the wake of its path. Public attention turned to CBR transport safety when an oil train derailment in Lac-Megantic, Quebec resulted in massive explosions and fatalities. This case made it clear that people who live in the blast zone, or in a 1-mile radius proximity to oil-carrying railway, disproportionately face the risks associated with CBR transport. Environmental justice (EJ) studies tell us that environmental harms are often felt unevenly where they are present, deeming people of color and impoverished people subject to making sacrifices for a supposed greater good. While most cases in EJ studies deal with fixed environmental threats, this study seeks to find nuance in the scalar theoretical underpinnings of EJ by zooming in and out on this mobile source of harm. By mapping and measuring oil train routes and demographic data in the city of Columbus, Ohio, this research begins on the local level of concentrated risk. The results show that impoverished people face disproportionate CBR risks in Columbus, an urban spaces linked to a national rail network within a global economy. However, just as an oil train moves between and beyond spaces of fixed threat, this research challenges single-scale perspectives of EJ, moving the framework from the local scale to the multiscalar.

1.1 Introduction

As the night sky was colored with the flames of fossil-fueled catastrophe, individuals in Lac Megantic, Quebec were forced to reckon with the global power of crude oil. In July of 2013,

national attention turned to the previously invisible vessels of crude oil that carry risk throughout the United States and Canada: oil trains. As hydraulic fracturing in the Bakken formation in North Dakota has successfully advanced new ventures in oil exploration over the last decade, crude oil production has skyrocketed, and with it, the need to transport oil (Conca, 2018). Clearly, with several cases of oil trains across the country derailing, spilling, and exploding, this need has not come without ramifications at the local level ("Crude Oil Transportation," n.d.). However, oil transport is not alone insofar as energy infrastructure has produced great, uneven harms across the continuum of energy production. The transformation of space by oil extraction and refining into "energy sacrifice zones" has been widely documented (Black et. al, 2014; Steady, 2009) leaving local marginalized populations to bear the environmental injustices associated with national and global accumulation of petrocapital.

Though oil train derailments have been the subject of wide news coverage and grassroots activism, environmental scholarship reveals a large gap in contextualizing this phenomenon within a broader landscape of energy and environmental justice studies. Environmental justice scholarship culminates in the widespread evidence that marginalized people are more likely to live in proximity to sites of concentrated environmental hazards, namely major large-scale infrastructure (Bullard, 2018; Cole & Foster, 2000; Lerner, 2010). Elsewhere, researchers have demonstrated that this relationship exists specifically in the case of transportation infrastructure (Chakraborty, 2009; Hricko, et al., 2014). This paper not only adds to these findings, but also implicates more wholly the process of energy production in this framework, a key piece missing in the literature. This research does so by bringing crude-by-rail (CBR) transport at the local urban level into the conversation. Specifically, I performed a spatial analysis of oil-carrying

railway along with socioeconomic demographics in Columbus, OH using Geographic Information Systems (GIS) to determine if CBR transport poses an environment justice threat in Columbus. The findings of this research allow oil trains to be used as a conceptual tool to think about environmental justice (EJ), energy justice (EnJ), sacrifice zones, and geographic scales. Environmental studies scholars and geographers alike have long called for critical interventions of multiscalar analyses of environmental justice, and this paper answers to that call. Though the methods used in this paper work in tandem with the principles of distributive justice characteristic of first generation EJ thinking, the directions of my findings lead the field into new scalar frontiers of Critical Environmental Justice Studies.

Therefore, I argue that CBR transport is an environmental justice concern in the city of Columbus, OH. While this research focuses on the local level analysis of this city, my findings, coupled with the nature of the oil train as a mobile source of risk, allows me to extend the local scale impacts to larger scales. Oil trains lend themselves to stretching current conceptions of EJ because, unlike most sources of risk, oil trains present a mobile threat to multiple communities across the energy spectrum. Where energy sacrifice zones are created on the front and back ends of the energy chain, I argue that oil trains conceptually and materially delocalize these threats, amplifying and connecting them on national and global scales. Oil trains centrally challenge the first generation approach to isolated scalar understandings of EJ and can lead scholars to deepen its spatial configurations.

1.2 Oil Production and Crude-by-Rail Transport

Catalyzed by the Organization of the Petroleum Exporting Countries' (OPEC) petroleum export ban, the energy crisis of 1973 shook the United States and consequently sparked a nationwide push for domestic energy reliance. By 1975, construction of the Alaska Pipeline was well underway and the Energy Policy and Conservation Act was signed by President Gerald Ford, effectively banning crude oil exports from the United States ("Timeline of Events," n.d.). Over the next 30 years, following Hubbert's peak theory, crude oil production followed an overall trend of declining production ("US Field Production," 2019). It was not until 2008 that unconventional oil production began to skyrocket with the dawn of hydraulic fracturing and the discovery of recoverable oil in the Bakken formation ("US Field Production," 2019). Production reached near-record highs with an average of 9.4 million barrels produced per day, marking almost a 90% increase by 2015 ("US Field Production," 2019). This ultimately paved the way for the crude oil export ban to be lifted for the first time in 40 years.

As upstream centers of extraction become overwhelmed with accelerating activity, networks of transport are increasingly needed to divert oil to midstream centers of refining and finally downstream terminals. By 2010, the oil volume extracted far exceeded the capacity of available pipeline infrastructure in the United States, deeming railway infrastructure crucial to filling this gap (Association of American Railroads [AAR], 2018). This shift, however, did not come without consequences. Since its surge in 2012, crude-by-rail (CBR) transport has brought with it a series of derailments, spills, and explosions (AAR, 2018). In Lac Megantic, Quebec the question of railway transport safety was begged when 63 Canadian Pacific tank cars derailed and exploded in 2013, taking 47 lives and forcing 2,000 others to evacuate their homes (Frittelli 2014). The ensuing fire destroyed several buildings in the Downtown area, calling for an

extensive emergency response (Transportation Safety Board of Canada 2014). Though Lac Megantic was the most fatal case in oil train history, other such cases demonstrate the environmental and safety hazards that oil trains pose to populations who live in proximity to CBR infrastructure. Just 5 months after the explosion of Lac Megantic, 34 BNSF crude oil tank cars derailed outside of Casselton, North Dakota, resulting in a massive fire and evacuation of 1,500 people in the area (Engel, 2013). In June of 2016, a Union Pacific oil train derailed and ignited, spilling oil into the Columbia River Gorge in Oregon (Geiling, 2016). These and many other instances of explosions, derailments, and spills resulting from CBR transport have brought into question not only what risks such transport poses, but also *who* stands to bear such risks.

1.3 Environmental Justice (EJ)

In 2016, non-profit groups ForestEthics and PennEnvironment released reports detailing the environmental injustice implications of CBR transport. Environmental justice (EJ) is a field constituted and constructed by activists and scholars who challenge the uneven nature of environmental harms distributed onto marginalized people at the hands of colonial-capitalist industrial expansion (Chiro 2016). As opposed to solely centering environmental protection and conservation like its environmental contemporaries, the EJ movement prioritizes the intersection of environment and culture as part of the everyday embodied realities of marginalized people across the globe. However, the way in which the movement has named and defined its goals over time has changed, dividing the field into two generations (Pellow 2016).

The first generation of EJ focused on documenting cases of environmental harms tied up with race and class and the strategies of activism employed to respond to such cases (Bullard

1994; Cole & Foster 2000). Much of the methodology characteristic of first generation EJ research involves using Geographic Information Systems (GIS) to map, systematize, and visualize hazardous sites and geodemographic data together to determine hotspots of environmental inequity and racism (McMaster et al. 1997). Known as Unit Hazard Coincidence, this methodological approach involves comparing a selected zone of hazard within a geographic unit to zones absent of that hazard to determine if some populations face a risk more than others (Mohai 2006).

As it stands, the EJ framework within the context of CBR operates from the standpoint of this first generation EJ scholarship. The ForestEthics and PennEnvironment nonprofit reports conclude that the risks of CBR transport disproportionately target racially and economically marginalized people situated in the blast zone in urban spaces The blast zone is used by the Department of Transportation to demarcate the 1-mile radius around crude oil-carrying railway in order to evacuate surrounding communities during fire or explosion emergencies (Krogh & Karras 2015). According to ForestEthics, California data revealed that compared to outside of the blast zone, a disproportionate percentage of POC live inside of the blast zone. Such was evident in communities within ForestEthics' study population like Oakland, Los Angeles, and Wilmington, where the number of people of color that live within the blast zone is overwhelmingly higher than the percentage of people of color who live outside of the blast zone. Similarly, in Pennsylvania, people of color across four communities faced higher health and safety risks than non-white people due to blast zone proximity. Such is evident in Pittsburgh, where approximately half of the city's population of color lives within the blast zone even

though the total population of color in Pittsburgh makes up less than 20% of the total population (Waldo 2016).

1.4 Energy Justice (EnJ) and Politics of Extraction

Despite the second generation's successful attempts at expanding the environmental justice framework beyond the scope of first generation concerns, energy remains an understudied issue within the broader movement. Scholars and activists have consequently articulated the concept of Energy Justice (EnJ) to call attention to the uneven nature of the energy continuum that produces and reproduces unequal harms and access to people across the world. Most salient in EnJ is the view that energy is a fundamental need crucial to sustaining populations and their livelihoods (Guruswamy, 2010). Energy poverty, then, is part and parcel of energy injustice because it restricts distributional justice via affordability and physical access (Jenkins, 2016). However, as Hernandez points out, injustice is not only found on the consumption side of energy, but also throughout the production sector (2015). From the initial point of extraction upstream to its distribution downstream, material capital involved in the production of energy is responsible for distributing uneven harms to proximate communities. This is evident in cases like coal mining in Appalachia, oil extraction in the Ecuadorian Amazon, and oil refining in Texas and Louisiana. Hernandez names these sites "energy sacrifice zones" wherein particular geographies of marginalized people are sacrificed in the name of national economic growth and energy demand (2015, p. 1). The crux of EnJ is that energy poverty and energy sacrifice are linked along the continuum of production and consumption of a greater good. In other words,

energy benefits at large-scale elsewheres sacrifice livelihoods, health, and cultures in local-scale spaces.

Energy sacrifice zones are highly visible in the context of crude oil production in the United States. With its rapid development in the Bakken formation over the past decade, hydraulic fracturing has brought with it vast social and political impacts on the local level. Fernando and Cooley, for instance, found that people living in the four major oil-producing North Dakota counties reported negative attitudes towards oil development based on community place-based values (2016). Residents expressed that infrastructure development and increased traffic negatively affected their connection to the land, while increased crime and an increasingly disproportionate male-to-female ratio diminished the sense of security that they once felt (Fernando & Cooley, 2016). Mrozla et al. took the latter finding further, discovering that fear of crime due to personal safety concerns and prior victimization among Williston, ND residents increased since oil production has rapidly grown (2018). Jayasundara et al. found that, in particular, perceptions of residents in the Bakken region held that sexual assault had risen in their communities, citing lack of affordable housing and substance abuse as key factors in this development (2018). All together, these studies make the case that oil development, though perhaps a means-to-an-economic-end at the national level, has serious consequences for community perceptions at the local level.

Linking sacrifice zones and national energy demands demonstrates that energy, in this case crude oil, functions on multiple levels and must thus be understood in multiscalar terms. Indeed, Jenkins et al. contend that energy must be studied through a whole-systems approach that succeeds in linking national regulatory institutions and actors to on-the-ground infrastructure

such as oil wells and nuclear mining (2016). Similar to EJ studies, studies in energy and EnJ have a tendency to overlook the multiscalar in favor of detailed accounts of single scale concerns like national policy-making and local extraction impacts. Because the energy system links and relates different political, social, and technological dimensions across the board, however, utilizing unitary scales of analysis does injustice to understanding the depth of energy conflicts. Similarly, from the geopolitical perspective, Mitchell points to the fallacy in understanding the oil curse strictly "within only one set of nodes of the networks through which oil flows... in the individual producer states," signaling the need to "follow the carbon" across networks and scales (2011, pp. 8-9). Citing Jenkins et al., Sovacool holds that undertaking a multiscalar analysis draws important attention to the systems and individuals responsible for creating conditions of injustice (2017). Therefore, understanding EnJ means breaking down the entire system of energy production and analyzing the way in which the system's material interconnections and co-dependencies produce and reproduce injustice and inequality.

1.5 Politics of Scale

Scale is one of the most central units of analysis in geographical studies, as it allows researchers to define the breadth and depth of issues pertinent to particular spatiotemporal conditions. According to Herod, "scale enables us to differentiate geographical landscapes, to delimit inclusion or exclusion in such social constructions as home, class, nation, rural, ruban, core, and periphery" (1991, p. 82). As such, these scales of analysis define the way in which power relations are constituted and contested, and therefore how questions of justice are defined. For example, in studying the multiscalar issue of airport expansion in Chicago, Cidell finds that

individuals who leverage their multiscalar positionality are more powerful in resisting large transportation projects than if they reduced the costs of such projects to the household-level scale (2006). Furthermore, labor unions, environmental justice movements, and indigenous people's organizations according to Leitner have utilized "scale jumping" to turn local conflicts into power conflicts on national and global scales (2008, p. 160). The co-production of scale and social actors demonstrates the dialectical relationship between spatiality and power.

The politics of scale enters this research in three ways. First, I will examine how environmental and energy injustice are produced by crude-by-rail transport through a multiscalar perspective. Second, I will zoom in on local level responses to CBR transport to investigate how scales are jumped by communities resisting oil trains. Lastly, I reflect on the "creative tension" in oil train geographical research that results from Smith's call for a "correspondence between the scale of real processes and events and the scale of analysis" (Jonas, 1994, pp. 259-260).

2.1 Research Questions

Given the increase of fossil fuel transportation via rail, and the inherent risks of catastrophe associated with oil production across the board, my research sought to explore the environmental justice and multiscalar components of CBR transport. Specifically, the empirical analysis of my research revolves around the following two research questions.

1. What is the relationship between race/ethnicity and proximity to Federal Class I railway infrastructure in the city of Columbus, OH?
2. What is the relationship between income and proximity to Federal Class I railway infrastructure in the city of Columbus, OH?

Beyond these questions that guide the empirical research element of the paper, this thesis seeks to engage with a conceptual question, specifically: How can the oil train as a conceptual tool stretch limits of environmental justice thinking to new multiscalar depths?

3.1 Methods

GIS was used to analyze the proximity of crude-carrying railway infrastructure to both people of color (POC) and impoverished people. Proximity in this research was measured at two levels according to Department of Transportation Blast Zone standards. The first measurement was made at the .5 mile radius level, which the DOT has deemed an evacuation zone for train derailments. The second measurement was made at the 1.0 mile radius level, which the DOT has deemed an "impact zone in case of fire" ("Do You Live" n.d.). Buffers were created for each radius measurement and overlaid with Census block groups within the political boundaries of Columbus, OH. Block groups that were at least partially in the buffer (i.e. within 0.5 or 1.0 miles of the railway line) were considered to be in the study population.

Each Census block group was joined with income, race, and ethnicity data from 2016 American Community Survey 5-year estimates. POC in this research includes all people in the Census who are not non-Hispanic White. The total POC population calculations were made by adding together population totals of African American, Asian, Indigenous, Bi- and Multi-racial, and Hispanic people in each block group. Non-Hispanic White people, then, constituted the remainder of the Columbus population. Socioeconomic status was measured using income at the household level. Those who had an income of $30,000 or less were considered to be economically marginalized, assuming that each household had an average of four people living in their homes. This number was used according to the federal poverty level at $30,000. Once the

researchers determined the definition of economic marginalization, households who had an income of $30,000 or less were added for the proximity analysis.

3.2 Research Area

The city of Columbus, the metropolitan capital city of Ohio, was selected for this analysis because it is home to two Class 1 Federal railways, CSX and Norfolk Southern. In Columbus, oil trains trudge quietly on Ohio State University's campus and in heavily populated neighborhoods such as Clintonville and Downtown. In 2012, the city confronted a fiery evacuation when eleven Norfolk Southern train cars carrying ethanol derailed in downtown Columbus (Associated Press, 2012). The accident did not result in any fatalities, but left significant infrastructure damage. Though this case did not involve crude oil, it demonstrated the danger of transporting volatile chemicals through urban centers.

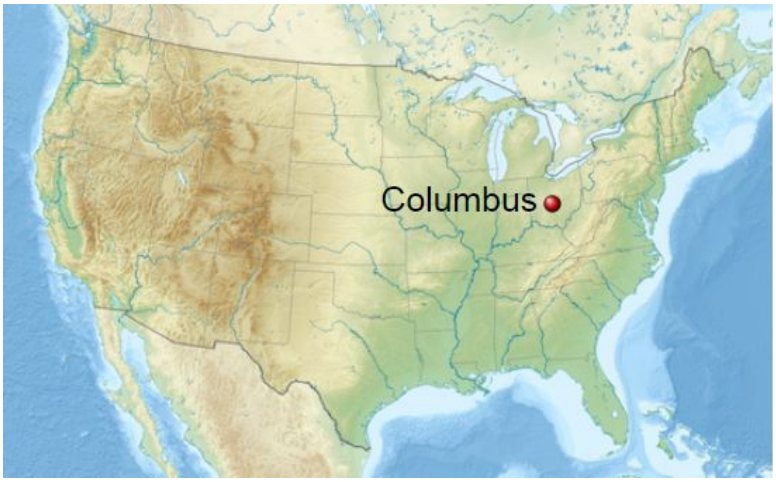

Figure 1: Location of Columbus, OH. ‘

Particularly important to getting a full image of current-day Columbus population demographics is understanding its long history of racial segregation. The Great Migration in the

1930s especially touched Columbus, whose African American population spiked in its East Side (Oliphint 2018). By the late 1930s, this racial segregation became further codified by the Home Owner's Loan Corporation, a group who notoriously demarcated Black and Immigrant neighborhoods with a shade of red, deeming such neighborhoods un-investable (Oliphint 2018). Known as redlining, this process has had long-lasting effects in Columbus up through today, where neighborhoods zoned as red are today places that experience concentrated poverty.

Based on calculations from ACS-2016 data, Columbus had a total population of 879,170 people in 2016. The racial-ethnic breakdown was as follows: 68.11% White, 19.01% African American, 0.3% Native American, 4.46% Asian, 0.1% Pacific Islander, 2.9% Other races, 3.3% Two or more races, 4.7% Hispanic or Latino of any race. The calculation of income from this research at the household level revealed that 10.99% of households live at or below the poverty line, while 89.01% live above the poverty line.

3.3 Data Analysis

The first step of this research was to map the extent of the rail infrastructure in Columbus. Railway infrastructure data was collected from the Ohio Department of Transportation and overlaid with the City of Columbus in ArcGIS. Non-Federal Class I railways, including rails spurs and regional rail lines, were removed from the analysis. The result is two main Federal Class I railways that travel through Columbus, one owned by CSX and two owned by Norfolk-Southern. The CSX line runs largely north-to-south, while one Norfolk-Southern line runs west-to-east and another runs north-to-south.

After defining and collecting data on GIS, descriptive statistics for populations in Columbus were calculated. Total population percentages were calculated based on the number of

people who lived inside of the blast zone and those who lived outside of the blast zone at the 0.5 mile radius level and at the 1.0 mile radius level. Then, based on the POC population inside and outside the blast zone at each level, total POC population percentages were calculated. The same analysis was used for poverty, where the total number of families inside and outside the blast zone at the 0.5 mile radius level and the 1.0 mile radius level were calculated. Then, based on the number of families in poverty inside and outside the blast zone at each level, total percentages of families in poverty were calculated at both radius levels.

The Statistical Package for the Social Sciences (SPSS) was used to calculate correlations and statistical significance for each dataset. Using census blocks as the unit of analysis, Pearson's chi-squared test was used to test the correlation between the respective variables. This was used to determine the correlation between the percent of race/ethnicity and proximity to the rail lines, and subsequently was used to measure the correlation between poverty and proximity. For measures of race/ethnicity, the percent of POC was measured for each census block. For measures of poverty, the percent of people living below the federal poverty line was measured for each census block. For measures of proximity, dummy variables were ascribed to the census blocks, with a 1 given to those that lie at least partially within the 0.5 mile and 1.0 mile geographic boundaries, and a 0 given to those that lie completely outside both the 0.5 mile and 1.0 mile geographic boundaries. Next, the T-test for Equality of Means Significance was used to test the significance of the correlations between race/ethnicity and proximity, and between poverty and proximity at the 0.5 mile and 1.0 mile radius levels.

4.1 Descriptive Analysis

Tables 1 and 2 reveal descriptive analyses of race at the 0.5 mile and 1.0 mile radius levels, respectively. 32.86% of the total Columbus population was found to live inside of the 0.5 mile radius blast zone. That leaves the remaining 67.14% of the Columbus population living outside of the 0.5 mile radius blast zone. The total percentage of POC living in the blast the 0.5 mile radius blast zone was 32.51% with a total percentage of 67.49% outside of the 0.5 mile radius blast zone.

Meanwhile, 46.71% of the total Columbus population was found to live inside of the 1.0 mile radius blast zone, with 67.14% of the remaining population living outside of the 1.0 mile radius blast zone. The total percentage of POC living in the blast the 1.0 mile radius blast zone was 47.12% with a total percentage of 52.88% outside of the 1.0 mile radius blast zone.

Race			
		Inside	Outside
0.5 Mile	Total Population	473462	967563
	% of Total Pop	32.86%	67.14%
	Total POC Pop	310042	149372
	% POC Pop	32.51%	67.49%

Table 1: Descriptive Statistics of Race at the 0.5 Mile Radius.

Race			
		Inside	Outside
1.0 Mile	Total Population	673058	767967
	% of Total Pop	46.71%	53.29%
	Total POC Pop	216459	242955
	% POC Pop	47.12%	52.88%

Table 2: Descriptive Statistics of Race at the 1.0 Mile Radius.

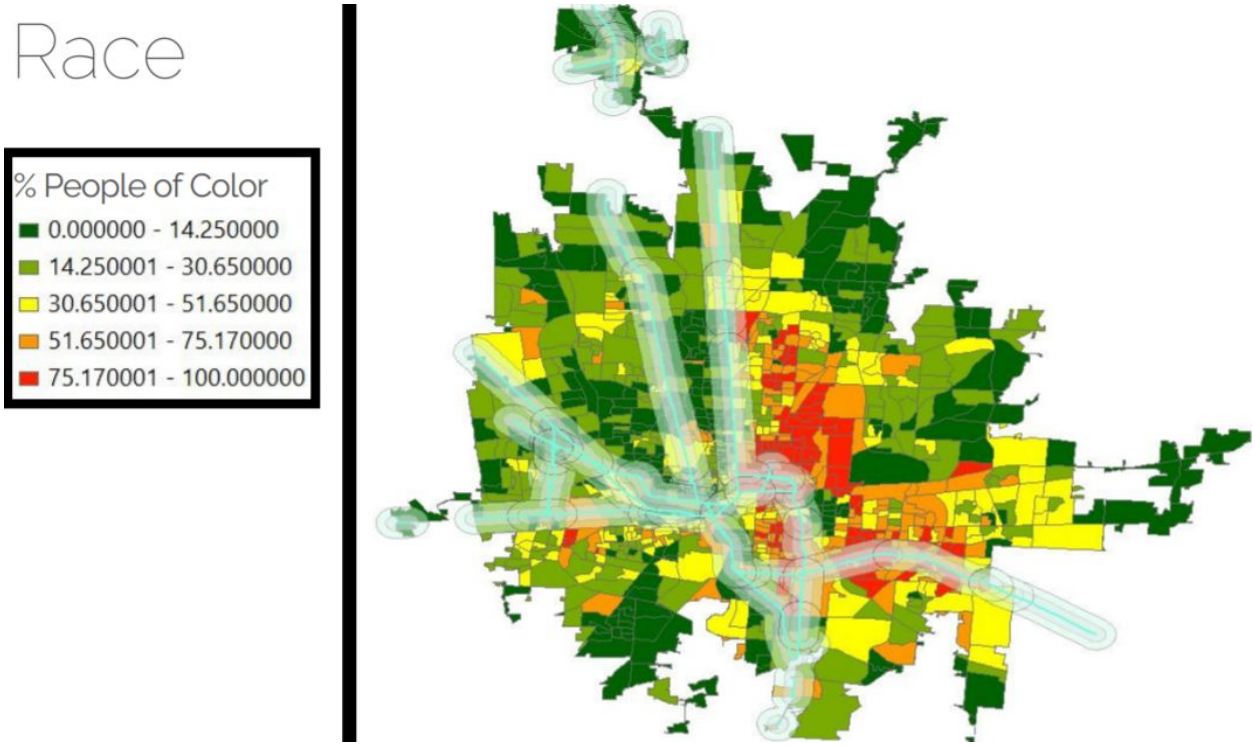

Figure 2: Racial/Ethnic Demographics and Railways in Columbus, OH

Tables 3 and 4 reveal descriptive analyses of poverty at the 0.5 mile and 1.0 mile radius levels, respectively. 16.65% of the total Columbus households were found to live inside of the 0.5 mile radius blast zone, which means that 83.35% of the remaining Columbus households are located outside of the 0.5 mile radius blast zone. The total percentage of households with incomes under the federal poverty line of $30,000 living in the 0.5 mile radius blast zone was 32.70% with a total percentage of 67.30% located outside of the 0.5 mile radius blast zone.

Meanwhile, 43.57% of total Columbus households were found to be located inside of the 1.0 mile radius blast zone, with 56.43% of the remaining Columbus households being located outside of the 1.0 mile radius blast zone. The total percentage households with incomes under the federal poverty line living in the 1.0 mile radius blast zone was 47.51% with a total percentage of 52.49% outside of the 1.0 mile radius blast zone.

Poverty			
		Inside	Outside
0.5 Mile	Total Population	57032	285462
	% of Total Pop	16.65%	83.35%
	Total Poor Pop	12306	25324
	% Poor Pop	32.70%	67.30%

Table 3: Descriptive Statistics of Poverty at the 0.5 Mile Radius.

Poverty			
		Inside	Outside
1.0 Mile	Total Population	149222	193272
	% of Total Pop	43.57%	56.43%
	Total Poor Pop	17819	19811
	% Poor Pop	47.51%	52.49%

Table 4: Descriptive Statistics of Poverty at the 1.0 Mile Radius.

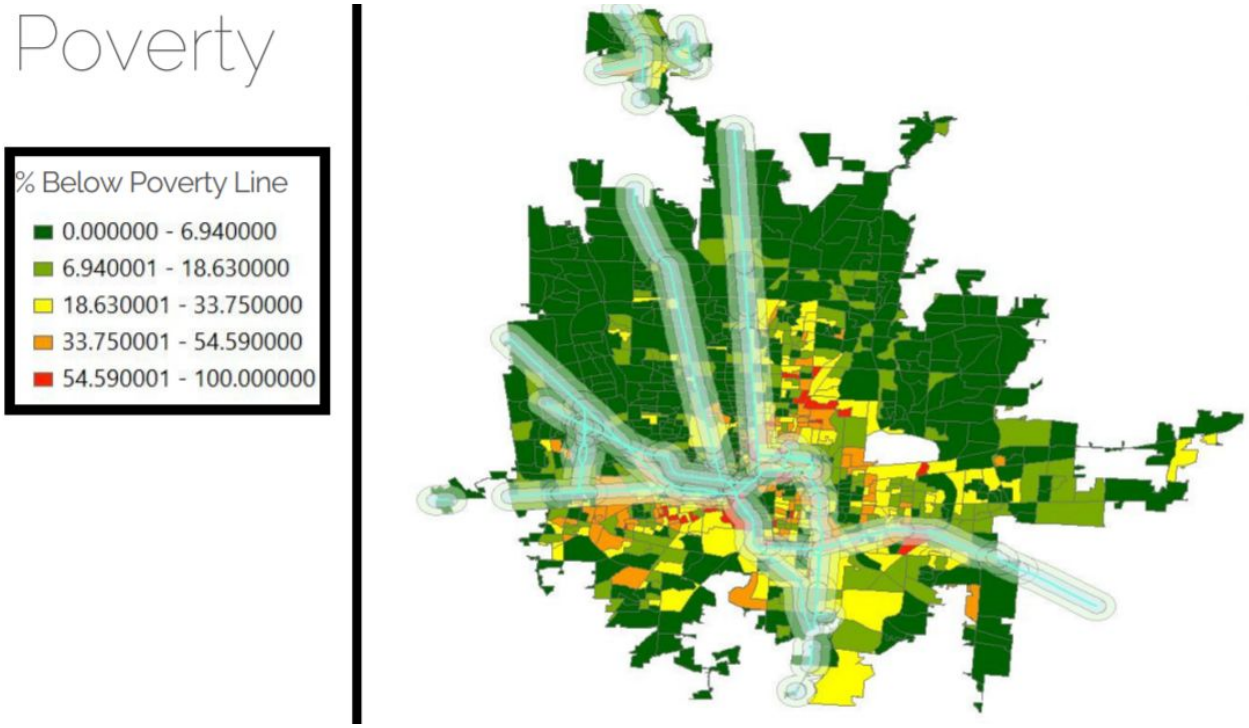

Figure 3: Poverty Demographics and Railways in Columbus, OH

4.2 Statistical Analysis

The Pearson's Correlation of Census Block racial/ethnic composition and proximity to railway revealed no statistically significant relationship between the variables. The Pearson's Correlation R-value for the 0.5 mile radius was .023, while Pearson's Correlation R-value for the 1.0 mile radius was .047. However, P-values for h of which were not statistically significant below the .1 or .05 levels. The Chi-square analysis showed similar results, with a T-test for Equality of Means at a significance of .468 at the 0.5 mile radius and T-test for Equality of Means Significance of .144 at the 1.0 mi distance.

The Pearson's Correlation of poverty and proximity to the railway did show a slight positive relationship. The values were r =.089 (p = .006) at the 0.5 mile radius level. The relationship was stronger at the 1.0 mi level, with a r = .115 (p = .000). The Chi-square analysis of poverty levels at different levels of proximity were similarly statistically significant, with the T-test for Equality of Means Significance reported at .006 for the 0.5 mile radius, and .000 at the 1.0 mile radius.

5.1 Discussion

Because the correlation between low income and proximity to crude oil-carrying railway was found to be statistically significant, there is sufficient evidence to suggest that oil trains in Columbus are an environmental justice concern. The correlation between people of color and proximity to rail was not found to be statistically significant, however. This research holds that in Columbus, people with low-income are more likely to face risks associated with CBR transport. This has real-world, material implications for on-the-ground realities of people in Columbus, as seen in other cases of oil train derailments such as that of Lac Megantic, Quebec. If an oil train

were to derail and explode in Columbus, people who live in the blast zone would be on the frontline of experiencing those risks. However, in tandem with cases in Pennsylvania, the blast zone is not a leveled space of equal experience. As these findings show, the 0.5 mile radius contains 32.7% of the Columbus households living in poverty, even though less than 17% of the total Columbus households are living in poverty. This points to a clear concentration of low income in the 0.5 mile radius blast zone and the general nature of the uneven conditions of energy landscapes.

5.2 GIS Drawbacks

Despite its usefulness, scholars have criticized using GIS for environmental justice research because, as with much social science methodology, it is theoretically challenging to measure human experiences of injustice with totalizing software. For example, EJ scholars have long debated that EJ cases change based on the scale of the geographic unit of measurement used (McMaster et al. 1997; Mohai 2006). That is, an EJ issue that may exist for communities at the county level may not be statistically significant for those at the local block group or census tract levels. Other criticisms hold that the distribution of environmental risks cross geographic boundaries such as those of Census tracts and block groups, leaving researchers unable to fully capture the populations at risk. All together, as useful as unit hazard coincidence was to identifying disproportionate impacts of sites of environmental toxicity to define EJ, scholars have found that it is insufficient for understanding both the full picture of harm and the conditions under which distributional injustice occurs.

As a result, second generation EJ is a growing field of scholarship that has moved towards expanding the EJ framework to issues of resource distribution and global justice. Of importance crucially has been the second generation's critical theoretical concern with race (Pulido 1996), space (Walker 2009; Holifield 2001), and gender (Buckingham & Kalcur 2009), among others. In particular, scholars such as Pellow (2016; 2018), Walker (2009), and Kurtz (2003) have demonstrated that EJ literature widely lacks a multiscalar understanding of environmental injustice, overwhelmingly lending itself to single-scale analyses of injustice and inequity. In his proposal for the formation of Critical Environmental Justice Studies, Pellow asserts that, "multi-scalar methodological and theoretical approaches to studying EJ issues... better comprehend the complex spatial and temporal causes, consequences, and possible resolutions of EJ struggles" (2016, p. 7). In response, the remainder of this discussion section will conceptually define scale and then zoom in and out on the case of CBR transport to demonstrate the multiple scales on which environmental injustice operates.

5.2 Politics of Scale

In studies where scale is used merely as a point of departure for analysis, most notably in empirical research, scales are taken for granted and thought to be unproblematic and "ontologically pre-given" (Delaney & Leitner, 1997, p. 93). Such is true of the use of scale as a fixed and natural concept in EJ. According to Kurtz, geographical interventions of scale have entered EJ in two ways; first through empirical studies that measure distribution of environmental hazards at different scales, and second through theoretical approaches that connect localized disparities to broader scales, the subject of this paper (2003). It is clear across

the board that while EJ necessitates the notion of scale to underpin analyses of uneven distributions of risks across space, critical analyses of scale itself are not undertaken. The former approach, while useful in establishing local-level tendencies of environmental injustices, is no longer appropriate to the expanding conceptualizations of EJ because, as demonstrated, the politics of scale where risks and social actors are present are inherently multiscalar. As Harvey put it, "there are no basic units to which everything can be reduced… the choice of scale at which to examine processes becomes both crucial and problematic" (1996, p. 203). This is especially true when using spatial units of measurement that aggregate material conditions of race and class, such as the Census block group or tract. Moving between such scales of analysis vastly reveals and masks uneven patterns of social relations and justice, skewing lived realities at different levels (Bouzarovski & Simcock, 2017).

As "social constructions," scales are dialectical in nature because they produce and are reproduced by social inequality (Herod, 1991). In other words, space is not just a "backdrop" for the existence of inequalities, but also an actor that actively produces them (Bouzarovski & Simcock, 2017). Such is evident within the long history of labor relations, where the localized scale of labor unions was effective in preventing a larger-scale move towards collective bargaining. The local scale itself defined the extent to which workers could organize, and what boundaries of aid could not be crossed, effectively isolating unions from one another (Herod, 1991). However, this scale was not a natural occurrence defined prior to workers organizing; rather it was constructed and manipulated by state- and federal-level legislation as a means to limit the power of labor organizing (Herod, 1991). Here, scale is produced by state attempts to "control the dominated" and thus is successful in reproducing hegemony (Jonas, 1994, p. 258).

Socio-spatial relations of labor are congruent to those of energy, insofar as national- and global-level energy scales of management organize the production of energy and localize its impacts within a network of "nodes" (Huber, 2015, p. 5).

5.3 Infrastructure and Scale

To begin to conceptualize the oil train across scales, its material components must be broken down and conceptualized. The risks that oil trains pose are a consequence of its three-pronged convergence of material infrastructure. First, CBR transport necessitates railway infrastructure for oil to be transported across space and between points of energy extraction and end-use. Second, vessels that can travel on the railway must be used to transport the oil. Finally, the crude oil itself is the substance extracted, transported, refined, and consumed. The component responsible for translating uneven risks across spaces-- that is, from the zone of extraction and across the network of transport-- is the crude oil itself. According to the Sightline Institute, the light, sweet oil extracted from the Bakken was confirmed by the US Pipeline Hazardous Material Safety Administration to be more flammable than other forms of oil, especially due to the high concentration of volatile organic compounds (VOCs) it contains (De Paul & Abbotts, 2014). This factor particularly highlights the capacity of crude oil to expand the spaciality of risk in ways that other goods transported by rail do not. However, this is not to say that the material oil itself is the sole culprit of environmental injustice. Rather, it is also the "social and financial power embedded in the substance" that rearranges the socio-spatial conditions of the landscapes it crosses (Huber, 2015, p. 5). Oil, a means-to-an-end of national capital accumulation, conceptually implicates a larger scale when transported. Where

on-the-ground explosions and derailments are experienced at the level of the body and locality, such instances of environmental harm function within a matrix of regional and national-level political-economic renderings. In this way, oil train catastrophes cannot be experienced solely on the individual and local levels insofar as its transport serves economic, political, and consumptive ends at larger levels.

Crude oil transcends the local scale and functions on broader levels not solely by virtue of its political-economic articulation, but also through the material infrastructure on which its transport relies. Where the oil substance acts at local and individual levels, the rolling train and the static railway cross over scalar borders, where the former bridges and acts at the regional level and the latter transposes all scales in terms of the national scale. The trains themselves travel on predetermined routes from zones of extraction to post-refinement terminal zones which often take the shape of rural and urban regions, respectively. Oil train routes as mapped by CSX, a Class I railroad company, reveal that networks of transport connect the Bakken basin to regions in the Eastern United States, such as the Midwest and the East Coast, thus consolidating space to be understood as a multi-region dependent construction ("Resources," n.d.). Here, the local is problematized and extended because it cannot exist isolated from other spatio-temporal moments of locality. Points of extraction, refinery, and end-use thus function together and co-create one another. They serve to bring together otherwise disconnected and even unrelated regions that mark different moments in energy production into a cohesive network of multiple related socio-spatial conditions.

Finally, the national scale of CBR transport is given by the far-reaching networks of physical railway laid across the nation. Where train cars move between demarcated points among

regions, the static railway infrastructure forms linkages of spaces and nodes of energy production across the United States, giving it the power to carve out and define landscapes of oil production across the entire country for even global ends. Since the lifting of the oil export ban in 2015, oil has been increasingly shipped out of the United States, opening up the path to becoming a net exporter for the first time in 70 years (DiChristopher, 2019). The comes at a time when oil production has been largely concentrated in Middle East, which has challenged the United States' claim to hegemony (Gokay 2015). As the drilling for oil continues in a move to reassert the United States' global economic and political influence, CBR transport is positioned as a tool to reproduce this power. Where pipelines no longer have the capacity to advance this mission, trains have become key to the functioning of United States economy and geopolitics.

5.4 Environmental Injustice via Infrastructure

My findings reveal that railway infrastructure cannot be thought of as monolithic, leveled, or apolitical. After all, were it not for the fixed railway networks that criss-cross and configure space unevenly on a national scale, oil risks would not be hypersensitive to differences along lines of class. The finding that economically privileged people are less proportionately susceptible to oil train risks than their counterparts in Columbus reveals that neither are oil trains neutral machines of equal risk simply because they move through all spaces regardless of social regional conditions. Quite the contrary, oil trains are produced by and reproduce social inequality, especially in terms of class. Similar to the effect of solely looking at climate change at the global level, taking a bird's eye view of oil transport levels the effects it has, which deems every person in its proximity equally susceptible to its associated harms. While it is important to

note that no one can really be immune to the impacts of oil transport while the maintenance of global hegemony and national capital accumulation depend on it, analyzing from the scale of the local rules that particular populations are more susceptible than others. Yet, understanding oil conflicts across the United States as products of a large network of linkages and not as isolated sources of conflict makes room to analyze environmental injustice as an issue beyond the local scale. Because the oil train functions on an energy continuum and as a result of interrelated regional, national, and global forces, conditions of environmental injustice *coexist* with the local. Injustice is produced by a multiscalar push for energy production that deems marginalized populations along the railway and pipeline, at the extraction zone, and in proximity to refineries and export terminals, at increased risk of exposure. So long as energy production is a webbed nexus that exists for larger scale gains at the disadvantage of local-scale actors, injustice constructs energy systems and permeates scales.

This conclusion can be reached by using a Census block empirical analysis at the urban local scale. That is, I zoomed in on the local spatial conditions of the city of Columbus in order to zoom out to the broader regional, national, and global levels for a conceptual analysis of environmental justice. Clearly, the two modes of inter-related analyses themselves function on different scales because my conceptual study did not rise out of a national empirical backdrop of analysis. However, this tension actually quite vividly paints the picture of the felt impacts of oil trains because local resolutions allow us to understand nuances that national scales otherwise totalize. Without starting from a standpoint of the local where material impacts such as explosions and fires are felt, oil trains could not be contested where national level discourses reduce their real risks to percentages. How the oil train is dialectically constructed and constructs

as I zoom in and out of scales emphasizes a need to map the everyday lived experience of the train.

5.5 Oil Train Conflicts of Scale

EJ must be rescaled in the academic literature because the lived experience of people on the ground demonstrates a different scalar thinking of CBR transport. As previously referenced, the scale literature has found that communities facing labor and environmental conflicts strategically conceptualize such conflicts to exist at larger scales. This is particularly true of oil train conflicts that are inherently multi-scalar in nature. While oil trains have been derailing, spilling, and exploding across the United States, communities in the Pacific Northwest in particular have mobilized within and beyond their localized scales to contest oil trains moving through their communities. In Spokane, WA for example, the city council passed a local resolution that urged federal and state leaders to "scrutinize" CBR transport (Brunt, 2014). Similarly, the Bainbridge Island, WA city council passed a resolution that called both for stronger regulations of oil trains and for a prevention of CBR shipments (Garza, 2014). In both these cases, two of many instances in the region, local-level decision makers with the support of community activists invoked the multiscalar by pushing action along decision makers at levels beyond their purview. By pushing local policy into the state and federal-level spheres, local-level actors situated the local effects of rail within a national policy discourse. Clearly, being spatially and practically restricted to making effective policy change at the local level meant that it was crucial to link their perceived threat to life to broader scales. The character of CBR transport as a

multiscalar issue is thus proved by the way in which oil trains are regulated at the national level and contested at the local level.

5.6 Limitations of Study

One of the biggest limiting factors of this study is that race/ethnicity and poverty were tested separately. This does not allow for a fair representation of which particular populations are more at risk than others, and it is difficult for these categories to be tested independently of one another since they are known to be closely linked. To add to this, geography limited to Census Blocks or Block Groups aggregates data and does not make room to look for disparities within these units. Therefore, if even a portion of the block was partially in the blast zone, the entire block was considered in the population, even if the majority of the block was not in the zone.

Furthermore, it must be understood that my findings in Columbus do not necessarily reflect material conditions in cities across the United States. Given Columbus' situated history and demographic patterns, it cannot be assumed that these findings can be extended until further research is done to investigate CBR transport injustice in other cities.

5.6 Future Research

Though this study is significant to begin to understand the relation between crude-by-rail transport, and by extension mobile sources of risk, and environmental justice, much work is needed to defend and extend the claims made. The next immediate step I recommend is for researchers to perform a national spatial analysis of oil-carrying railway and racial, ethnic, and income demographics. Because energy transport shapes entire macro-level landscapes, it is

necessary to understand how race and class function on this larger landscape. This research demonstrates how risk to marginalized people works at the local urban level but must crucially be situated in a larger context of racism and classism. I also recommend that future researchers do a comparative analysis of urban and rural sectors to investigate how differences in vulnerabilities play out. That is, do regional spatial differences reveal patterns of injustices along lines of race and class?

This study does not and should not discount the real ways in which spaces are racialized and oil production occurs in racialized capitalism. This research should not speak for the relationship between race and environmental injustice via oil train risks in other cities and/or nationally, namely because the history of Columbus places it at a unique point. Because of its overt segregation carved out by Interstate 71 and the adjacent rail line, people of color, predominantly Black people, are relegated to the East Side beyond the railway. The railway is only the starting point that marks this concentrated zone of ethnically and racially marginalized people. As shown in Figure 2, the concentration of people of color is east of the railway. Further studies in Columbus might look at the effect that railways had in the carving out of the segregated city.

While race/ethnicity and proximity to oil trains was not found to be statistically significant, it is possible, if not likely, that there is still an underlying relationship between race and proximity that could be better articulated with different methods. In this study, race and ethnicity were coded with dummy variables (Census Blocks inside or outside the blast zone), and this methodology offers a clear and simple way to test the correlation between race and proximity. However, finer tuned measures are lost with this technique. It is possible that specific

ethnic groups (such as Latinx people) may be at a disproportionate risk of proximity, but not accounted for when all non-white races are lumped together. It is recommended that future research explore different methods to test the relationship between race and railway proximity.

Finally, it is not enough to do spatial analyses to understand environmental injustice. Multi-method research through surveys, interviews, and/or focus groups is needed to understand how people see and react to oil train infrastructure in their communities.

6.1 Conclusion

In this study I invoked a multiscalar analysis of CBR transport not only to answer to what critical EJ theorists have seen as a gap in EJ research, but also to both open pathways for what future multiscalar EJ analyses can look like, and how the energy production process must be implicated in EJ. I did so by engaging the multi material scales of oil production against the backdrop of the scale of spatial demographics in city of Columbus, Ohio for analysis. Measures of poverty among residents of Columbus showed a statistical relationship to proximity with oil train infrastructure, and thus a relationship to increased vulnerability to risks from oil train derailment and explosions. The findings here were more nuanced, however, in that I did not find a similar relationship with race or ethnicity and proximity. This research demonstrates that notions of EJ and equity must remain on the forefront of policy, regulation, and civic actions on the transportation of crude oil by rail. This research also illustrates both the strengths and weaknesses of spatial-proximity analyses that examine environmental justice issues, and highlights the vast need for more research to document and understand the wide dispersion of costs and benefits associated with oil infrastructure.

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